ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

FINAL REPORT

FY95 LIMITED ENERGY STUDY
FOR THE AREA "A" PACKAGE BOILER

HOLSTON ARMY AMMUNITION PLANT
KINGSPORT, TENNESSEE

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Prepared For:

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I. Executive Summary

Introduction

In March 1995, Affiliated Engineers SE, Inc. (AESE) was retained by the Mobile District U.S. Army Corps of Engineers to perform a Limited Energy Study for Holston Army Ammunition Plant, Kingsport, Tennessee.

The field survey of existing conditions was completed in May 1995. The results of this field survey were subsequently tabulated and used to generate single line building drawings on Autocad.

This report summarizes the results obtained from this field investigation and the analysis of various alternative Energy Conservation Opportunities (ECO's). To develop the field data into various alternative ECO concepts or models, we utilized an "Excel" spreadsheet to tabulate and compare energy consumption, installation and operating costs for various ECO's.

These ECO's were then analyzed for suitability for the Energy Conservation Investment Program (ECIP) using the government's software package called Life Cycle Cost in Design (LCCID).

Scope of Work

The Scope of Work developed by the U.S. Army Corps of Engineers gave the following tasks:

1. Perform a field survey to gather information on existing operating conditions and equipment at Holston Army Ammunition Plant, Area "A".
2. Perform a field survey to gather information on existing boilers laid away at Volunteer Army Ammunition Plant in Chattanooga, Tennessee.
3. Provide a list of suggested ECO's.
4. Analyze ECO's using the LCCID program.
5. Perform savings to investment ratio (SIR) calculation.
6. Rank ECO's per SIR's.

7. Provide information on study assumptions and document equations used in calculations.

8. Perform Life Cycle Cost Analysis.

9. Perform Synergism Analysis.

10. Calculate Energy/Cost Ratios.

11. Calculate Benefit/Cost Ratios.

12. Provide documentation in the form of Project Development Brochures (PDB's) and DD Form 1391.

13. Provide recommendations for implementation of ECO's into projects by ECIP priority.

14. Prepare a report to document the work performed, results, and recommendations.

Buildings examined for Energy Conservation Opportunities were as follows:

Area "A" Building 8-A Steam Plant

Area "A" Building 7-A Acetic Anhydride Manufacture

Description of ECO's

Six alternate methods (ECO's) of providing and/or utilizing thermal energy, in the form of steam, in the acetic anhydride production processes at Area "A" were studied. One ECO addressed operating procedure change only, with no associated first cost. Two ECO's addressed operation using boilers relocated from Volunteer Army Ammunition Plant (VAAP), Chattanooga, Tennessee; these ECO's differed in system operating procedures, but had identical estimated first cost. A final ECO addressed the provision of a new 100 psig, natural gas fired, 30,000 lb/hr capacity boiler and the layup of the existing 400 psig boiler system.

The six ECO's were each compared to baseline conditions which were developed from historical data, with data extrapolated to represent the anticipated 1996 production of 2 million lbs equivalent RDX explosive.

The following description for Case 1 represents baseline system configuration.

Case 1

Existing stoker operated, coal fired boilers producing 400 psig, 575°F steam utilized at non-condensing turbines driving boiler feedwater pumps, boiler ID/FD fans, and 1,000 hp river water pumps. The river water pump backpressure turbine exhaust steam at 100 psig, augmented by steam from a pressure reducing station, is utilized for thermal requirements of the acetic anhydride chemical processes, as well as building and storage tank heating and pipeline steam tracing. Other turbine exhaust at 5 psig is used within the boiler room, primarily for feedwater heating in the deaerator. In addition, the case simulation includes manual discharge of steam so as to preclude boiler operation below 40,000 lbs/hr output, below which it has been found to be impossible to avoid boiler stack emissions limit violations.

Energy conservation opportunities studied in depth are further defined in Case 2 through Case 7 hereinafter.

Case 2

The system configuration is identical to the baseline, but existing electric driven feedwater and river water pumps are utilized in lieu of the turbine driven units.

Case 3

The Case 2 scenario is modified by retrofit of one of the six stoker operated, coal fired boilers with a natural gas burner installed in place of an existing (abandoned) producer-gas-tar burner on the furnace wall opposite the stoker drives. A nominal 50,000 mbh burner is considered, giving output modulation capability down to 20,000 #/hr steam output or below.

Case 4

Dual fuel boilers relocated from VAAP, producing 350 psig saturated steam, serve the pumps and thermal processes of the baseline (Case I) system configuration. Turbine driven ID/FD fans of the baseline system are not utilized, and electric driven forced draft fans relocated from VAAP are included. Existing deaerating heater systems and other water treatment equipment are retained.

Case 5

The system configuration is identical to Case 4 (with relocated VAAP boilers), but existing electric driven feedwater pumps and riverwater pumps are utilized in lieu of the turbine driven units.

Case 6

Building 8A is "Layed Away" for future reactivation when required, and 100 psig steam demands are accommodated by a new packaged 850 bhp water tube boiler, natural gas fired, with light oil burning capability for standby purposes. The new boiler and feedwater/condensate conditioning and pumping equipment are proposed to be installed at the ground floor of Building 7 to the east of the existing heat recovery boiler. Natural gas is delivered to Building 7 at the northeast corner through an existing 6 inch supply pipe. Building 7 contains 32 cracking furnaces fired by natural gas from the 6 inch supply pipe, but at anticipated near future production levels, a limited number of furnaces will be active, leaving ample gasline capacity for boiler fuel.

Case 7

All conditions of the steam system of Case 6 are identical in Case 7. Because there is considerable uncertainty in estimating reduced fixed maintenance and overhead costs realized by deactivating boiler plant Building 8, the assumed Case 6 fixed maintenance cost of $3,750 per month is increase to $6,250 and the Case 6 fixed overhead cost of $35,000 per month is increased to $50,000. In effect, Case 7 provides a sensitivity indicator for evaluation of assumptions.

Case 8

All conditions of the steam system of Cases 6 and 7 are identical, but non-recurring savings (maintenance and overhead) was adjusted interactively within the LCCID program until the resultant SIR value was below the ECIP limiting criteria of 1.25. This minimum non-recurring savings amount was $665,000.

It represents variable maintenance and overhead costs identical to Cases 6 and Case 7 ($326,105); derived as follows:

	Case 7	Case 8
Total Non-Recur. Savings:	$ 1,001,105	$ 791,106
Less Fixed Savings:		
Case 6 - 12 ($6,250 + $50,000)	675,000	
Case 7 - 12 ($3,750 + $35,000)		465,000
Variable Non-Recurring	$ 326,105	$ 326,106

The Case 8 calculated fixed monthly maintenance and overhead savings is as follows:

$$\text{Savings} = \frac{\$665{,}000 - \$326{,}105}{12} = \$28{,}250 \text{ per month}$$

This value compares to the baseline case assumption of $56,250 per month ($37,500 fixed maintenance + $18,750 fixed overhead).

Other Alternatives

An additional ECO was considered to retrofit existing 100 psig firetube heat recovery boilers at the Acetic Anhydride Manufacturing Facilities in Building 7-A with supplemental natural gas burners. It was abandoned after partial analysis indicated its system control complexity required to accommodate variations in the sequencing and operation of the 32 cracking furnaces, representing the waste heat source, rendered this ECO infeasible.

As an alternative to purchasing a new 100 psig boiler, AESE was requested to provide a cursory evaluation of costs and conditions for rental or lease of a new boiler system equivalent to the case 6, 7 and 8 proposed boiler three firms advertising in trade magazines as having boilers for rent/lease were contacted. Indeck Power Equipment Co. provide a proposal for an 800 hp boiler and deaerator at $3,800 per month, minimum 3 year term. Their written proposal is presented in Appendix 9. An LCCID analysis was performed for reference, identified as Case 9, described as follows:

Case 9

The energy related data of Case 8 are duplicated for leased equipment on a 3 year lease. Because a 3 year life is used, this data is for information only and cannot be directly compared to other cases.

FINDINGS, ANALYSIS AND RESULTS

It was determined that significant fossil fuel energy savings could be realized by utilizing natural gas fuel in lieu of coal at the extremely low explosives production rate projected for 1996, with moderate increase in electrical energy consumption. Quantified values are as follows:

CASE NO.	FOSSIL FUEL ENERGY REDUCTION
	BASELINE
2	(46338 - 46338) (12) = 0 MMBtu/yr
3	(46338 - 25504) (12) = 250,008 MMBtu/yr
4	(46338 - 25173) (12) = 255,180 MMBtu/yr
5	(46338 - 25173) (12) = 255,180 MMBtu/yr
6	(46338 - 23238) (12) = 277,200 MMBtu/yr
7	(46338 - 23238) (12) = 277,200 MMBtu/yr
8	(46338 - 23238) (12) = 277,200 MMBtu/yr
9	(46338 - 23238) (12) = 277,200 MMBtu/yr

CASE NO.	ELECTRICAL INCREASE
	BASELINE COMPARISON
2	3350 - 28857 = -25507 MMBtu/yr
3	3350 - 26037 = -22687 MMBtu/yr
4	3350 - 5534 = -2184 MMBtu/yr
5	3350 - 35372 = -32022 MMBtu/yr
6	3350 - 32587 = -29237 MMBtu/yr
7	3350 - 32587 = -29237 MMBtu/yr
8	3350 - 32587 = -29237 MMBtu/yr
9	3350 - 32587 = -29237 MMBtu/yr

Results of the LCCID analysis, prioritized by descending SIR, are as follows:

Priority No.	Case No.	SIR	Total Investment	Simple Payback
1	6	10.70	$ 420,000	0.68
2	7	4.78	$ 420,000	1.03
3	8	1.22	$ 420,000	1.49
4	4	-2.74	$ 350,000	2.53
5	5	-10.75	$ 350,000	-4.09
6	3	-87.22	$ 65,000	-0.27
7	2	--	$ 0.00	--

The two analysis runs producing ECIP qualifying results (Construction Cost >$300,000, SIR>1.25 and simple payback <10 years) are both for a new 100 psig firetube boiler proposed for installation in Building 7-A, and represent "sensitivity analyses" of assumed savings. Operation with the new boiler saves fossil fuel energy at the expense of increased electrical consumption. The net result is reduced total energy consumption of 247,963 million Btu/yr.

Results of cursory analysis of a 3 year lease of the proposed new boiler (Case 9), compared to Case 8 purchased boiler at 15 year life cycle are as follows:

Case No.	SIR	Construction Cost	Simple Payback
8	1.22	$ 595,000	1.40
9	1.26	$ 375,00	1.26